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Anesthesia and Restraint for the California Sea Lion, *Zalophus californianus*

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SUMMARY

A pinniped restraining cage was developed for examination, treatment, or induction of anesthesia. Inhalation anesthesia with halothane was found to be satisfactory because of rapid induction and recovery. Physiologic adaptations to life in the aquatic environment (especially in thermoregulation) appeared to limit the usefulness of barbiturates, phencycladine,* and phenothiazine-derived tranquilizers.

The California sea lion, *Zalophus californianus*, is the marine mammal most frequently found in captivity throughout the world. It is the performer in virtually all of the "trained seal" shows seen in circuses, zoos, aquariums, amusement parks, and oceanariums. Sea lions are frequently photographed balancing a ball at the tip of the nose. Because of near-insatiable appetites, they rapidly learn to perform "tricks" when successful performance is rewarded with offerings of food.

California seas lions are members of the order of Pinnipedia. The order is divided into 2 superfamilies, the Phocidae or true seals and the Otarioidea which includes the Odobenidae (walrus) and the Otariidae (eared seals). The eared seals are found mainly in the northern Pacific and Antarctic oceans, and are represented by about 12 species, some of which are commonly called sea lions and others fur seals.[2]

Zalophus californianus is kept at the Marine Bioscience Facility, Point Mugu, Calif., for the purpose of research. Highly trained California sea lions are used in investigations of diving physiology, underwater audition and vision, as well as in experiments to determine how these animals can be used to aid man in the scientific investigation of the sea. Other aspects of *Z. californianus* as a laboratory animal have recently been reviewed.[1]

As is the case with wild animals, restraint is the first problem facing the clinician in examining and treating sea lions. Unless care is exercised, restraint can be more damaging than the condition for which the animal is being treated. In addition, sea lions have large sharp canine teeth, strong jaws, and a flexible body that defies restraint; it has not been uncommon for handlers, trainers, or veterinarians to sustain severe bites.

Sea lions can usually be driven into cages or pens without difficulty, and they can also be trained to voluntarily enter a cage after only a few trials. This feature has permitted the development of a restraining cage that is both humane

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* Sernyl, Parke, Davis & Company, Detroit, Mich.

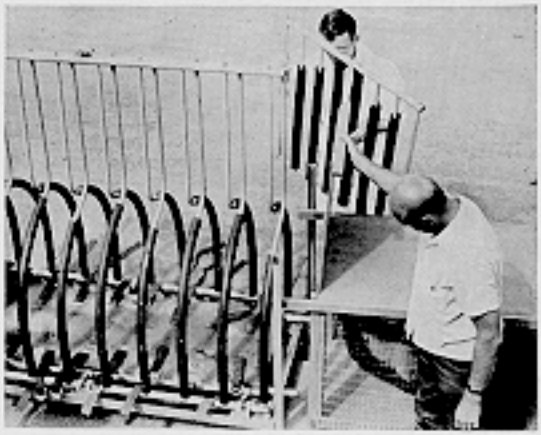

Fig. 1—Sea lion driven from transport cage to restraining cage.

for the sea lion and safe for the handlers. The floor of the cage consists of a removable tie-down board with straps that can be adjusted for various-sized animals. Its sides are interlocking metal bars padded with a soft closed-cell neoprene insulating material.* This material has about the same tensile strength as human flesh and gives the sea lion something to sink its teeth into. The outer covering is "shrink" tubing** which keeps the padding material from tearing. The ends of the cage are lift-up doors, with metal bars similarly padded. For mobility, the whole cage is mounted on 6-inch casters.

* Vascocel, Arrow Risco, Inc., Los Angeles, Calif.
** Newark Electronics Corporation, Chicago, Ill.

Fig. 2—Sea lion completely restrained by the cage bars.

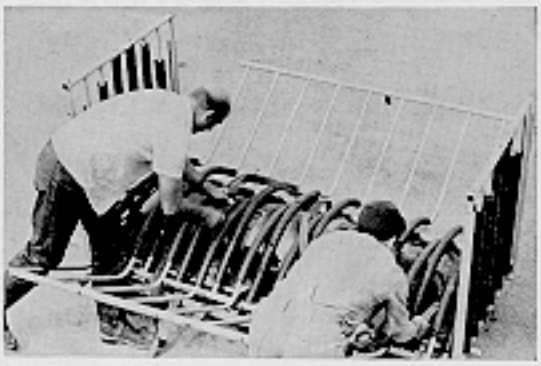

Fig. 3—Sea lion in strapped-down position.

After the sea lion is lured or driven into the cage, the sides are closed down in scissor-like fashion, the animal is pressed into ventral recumbency on the board and is then strapped down (Fig. 1–6). The bars are then released and set aside, and the board, with the animal strapped securely to it, may now be lifted out and taken to the examination room or into surgery (Fig. 6).

Anesthetic Agents

We have tested a number of anesthetic agents for use in California sea lions prior to adopting the present procedure. Agents that provide a quick "knock down" and can be fired in a projectile syringe* have been used because they appeared to provide a safe and efficient means of approaching and restraining an animal. Succinylcholine chloride** and gallamine triethiodide† have yielded mixed, but usually poor, results, however, because intramuscular dosages sufficient to restrain the animal have often resulted in extremely prolonged duration of action and sometimes eventual respiratory failure. Anesthesia can also be induced with barbiturates. Recovery is, however, prolonged, and body temperature may drop considerably. Venipuncture is often difficult in sea lions that are awake and thus even ultra short-acting barbiturates have been avoided

* Cap-chur Syringe, Palmer Chemical and Equipment Company, Douglasville, Ga.
** Succostrin, E. R. Squibb & Sons, New York, N.Y.
† Flaxedil, Davis & Geck, Division of American Cyanamid Company, Danbury, Conn.

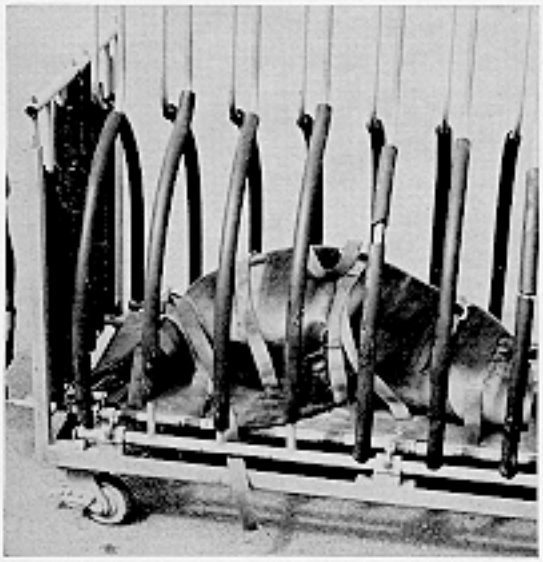

Fig. 4—Cage with side bars released, straps tightened, and cage floor disengaged.

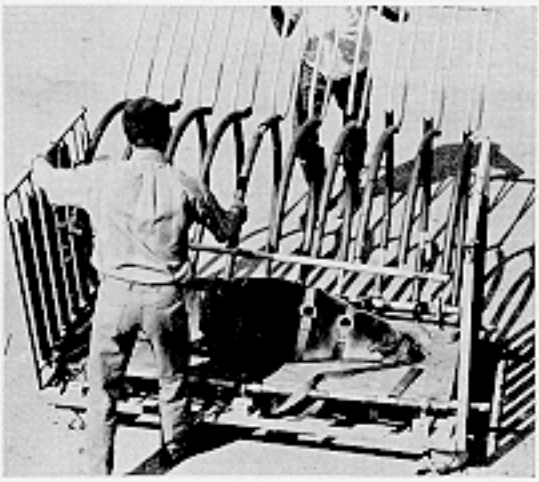

Fig. 5—Cage with side bars and end removed.

because of difficulty in administration. The use of peripheral vasodilators, or ganglionic blocking agents, or agents that produce a marked depression of the hypothalamus should be avoided in marine mammals, unless the clinician is prepared to control body temperature for the duration of their effect. Such agent sinclude phenothiazine-derived tranquilizers such as chloropromazine HCl and promazine HCl. Although it has been previously suggested that perphenazine HCl,* trifluromeprazine HCl,** and hydroxyzine HCl† could be employed if used with care,[1] and quite a number of marine mammals have survived various dosages, it now appears that their detrimental effects on temperature regulation alone contraindicate the use of this whole group of drugs in any marine mammal. When the use of a tranquilizer is indicated, chlordiazepoxide HCl‡ or diazepam§ appear, for the present at least, to warrant the most consideration. We have not employed any of the meprobamate derivatives; these drugs might also warrant consideration.

Phencycladine HCl* has been used alone and in combination with other drugs, and although results have been satisfactory on occasion, our overall impression of its usefulness has not been favorable.

In our experience with anesthesia for marine mammals, we have found that rapid and complete recovery from anesthesia are of primary importance. For this reason inhalation has been the most satisfactory route of administration and halothane** has been the agent we have used almost exclusively.[3,4]

* Trilafon, Shering Corporation, Bloomfield, N.J.
** Nortran, Norden Laboratories, Lincoln, Neb.
† Atarax, Charles Pfizer Company, N.Y.
‡ Librium, Roche Laboratories, Nutley, N.J.
§ Valium, Roche Laboratories, Nutley, N.J.

* Sernyl, Parke, Davis & Company, Detroit, Mich.
** Fluothane, Ayerst Laboratories, Inc., New York, N.Y.

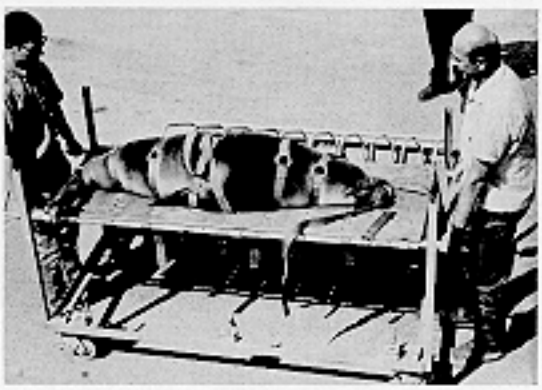

Fig. 6—Cage bottom containing the securely restrained animal carried to surgery or examination. Slots in the cage bottom allow adaptation for animals of various sizes.

Fig. 7—Hood placed over animal's head for inducing anesthesia.

Anesthetization Procedure

The sea lion is driven into the squeeze cage, restrained, and strapped to the board. Atropine (about 1/60 gr. for a 50-kg. sea lion) is given subcutaneously as the only preanesthetic medication. The sea lion is then carried into surgery where a glass hood (Fig. 7 and 8) is placed over the head. Induction is started, with halothane being introduced into the hood through a respirator.* The vaporizer** is set at 10% for induction, but the air actually inhaled by the sea lion probably does not contain a con-

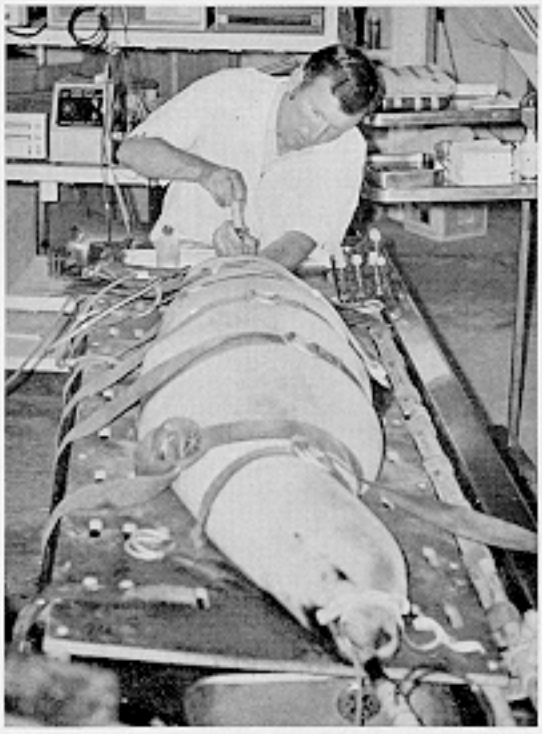

Fig. 9—Preoperative blood sample taken after intubation.

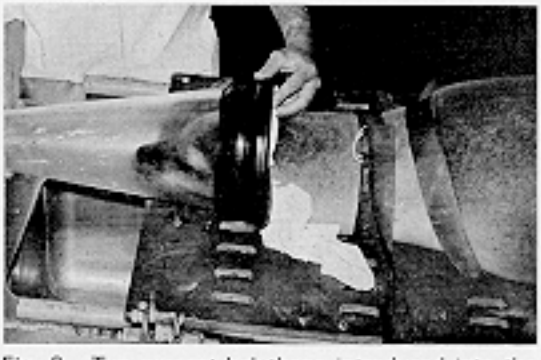

Fig. 8—Ten percent halothane introduced into the hood. Soft paper towels are placed around the end of the hood to reduce escape of halothane. Some air is permitted to escape to prevent excessive accumulation of carbon dioxide. Clear glass construction is mandatory in order to observe the sea lion during induction.

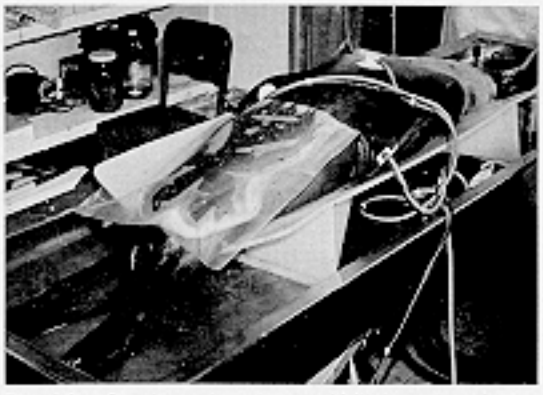

Fig. 10—Sea lion placed on a "V" board and prepared for surgery. A sterilized form-fitting plastic drape is placed over the surgical area. Active-vacuum silicone rubber suction cups house ECG electrodes. One electrode is placed on each flipper and one at center of chest.

* Bird Mark 9 respirator, Bird Corporation, Airport, Palm Springs, Calif.

** Fluotec vaporizer, Cyprane, Ltd., London, England.

centration that great. Respiration is monitored (and the eyes, nares, and some mucous membranes can be seen) through the transparent hood.

Anesthesia in small sea lions may be induced in 5 minutes, but larger ones may require 20 minutes. When a sea lion is fully anesthetized, the hood is quickly removed and an endotracheal tube is inserted. Intubation must be done rapidly or the animal will recover from anesthesia before it is completed. In this event, the hood is replaced for a few minutes, after which intubation is again attempted. After intubation, the vaporizer setting is reduced to 2.5 or 3.0 and lowered further as clinical signs indicate. After intubation, a preoperative blood sample may be taken from the spinal blood vessels in the lumbar region (Fig. 9).

Silver-silver chloride electrodes inside silicone rubber suction cups attached to an active vacuum system are employed to monitor heart action (Fig. 10); the electrocardiogram is amplified and displayed on an oscilloscope. The sunction-cup electrodes can be applied to any point on the animal and they work well under water.

Halothane concentrations of 0.75 to 1.5% have been required to maintain anesthesia over prolonged periods. Recovery in all instances has been rapid. It is quite gratifying to have a sea lion barking and moving around without ataxia 1 hour or less after surgery.

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